CLAIMS

WHAT IS CLAIMED IS:

1. A multilayer optical fiber coupler for coupling optical radiation between an optical device and an optical fiber, comprising:

a first layer, said first layer defining a fiber socket formed by photolithographic masking and etching to extend through said first layer, said fiber socket sized to receive and align said optical fiber therein;

a second layer bonded to said first layer; and

said optical fiber having an end section that extends through the fiber socket, said optical fiber terminating at an end face situated approximately adjacent to the second layer, said fiber socket aligning and positioning said optical fiber therein.

2. The optical fiber coupler of claim 1 wherein said optical fiber comprises a single mode optical fiber.

3. The optical fiber coupler of claim 1 wherein said first layer comprises substantially single-crystal silicon.

4. The optical fiber coupler of claim 1 wherein said second layer comprises silicon.

5. The optical fiber coupler of claim 1 wherein said second layer has an index of refraction substantially equal to the index of refraction of the core of said optical fiber.

6. The optical fiber coupler of claim 5 wherein said second layer comprises glass.

7. The optical fiber coupler of claim 1 and further comprising an epoxy that fills the gap between the end face of the optical fiber and the adjacent portion of the second layer, said

epoxy having an index of refraction that approximately matches the index of the optical fiber so that optical losses are reduced.

8. The optical fiber coupler of claim 1 and further comprising an optical device integrated into said second layer.

9. The optical fiber coupler of claim 8 wherein said optical device comprises a VCSEL to provide an integrated fiber optic transmitter.

10. The optical fiber coupler of claim 8 wherein said optical device comprises a photodetector to provide an integrated fiber optic receiver.

11. The optical fiber coupler of claim 1 wherein said second layer comprises an optical focusing element arranged to couple optical radiation with said optical fiber.

12. The optical fiber coupler of claim 11 wherein said optical focusing element has a focal point for optical radiation from the optical device, said optical fiber includes a core and a cladding surrounding said core, and said focal point is approximately situated along the central axis of said fiber socket, so that the optical radiation is coupled into said core of said optical fiber.

13. The optical fiber coupler of claim 12 wherein said optical fiber comprises a single mode fiber.

14. The optical fiber coupler of claim 11 wherein said optical focusing element comprises a refractive lens.

15. The optical fiber coupler of claim 11 wherein said optical focusing element comprises a gradient-index lens.

16. The optical fiber coupler of claim 11 wherein said optical focusing element comprises a diffractive lens.

17. The optical fiber coupler of claim 1 and further comprising a third layer bonded to said second layer, said third layer comprising an optical device.

18. The optical fiber coupler of claim 17 wherein said optical device comprises a VCSEL.

19. The optical fiber coupler of claim 17 wherein said second layer comprises an optical focusing element.

20. The optical fiber coupler of claim 17 wherein said third layer comprises an optical focusing element.

21. A method for making a plurality of monolithic optical fiber couplers that align an optical fiber that have a predetermined diameter, comprising:

photolithographically masking and etching a first layer to form a plurality of through holes through the first layer, thereby forming a plurality of cylindrical fiber sockets in a predetermined configuration, said fiber sockets having a diameter approximately equal to the diameter of the optical fiber;

bonding said first layer to a second layer together to provide a composite wafer;

dicing said composite wafer into a plurality of chips, each chip including one or more fiber sockets; and

affixing optical fibers into said fiber sockets.

22. The method of claim 21 further comprising:

forming a plurality of VCSELs in said second layer in a predetermined configuration corresponding to the configuration of said fiber sockets; and

aligning said first layer with said second layer so that said VCSELs are aligned with said fiber sockets, and then performing said step of bonding said first and second layers together to provide said composite wafer.

23. The method of claim 21 further comprising:

forming a plurality of photodetectors in said second layer in a predetermined configuration corresponding to the configuration of said fiber sockets; and

aligning said first layer with said second layer so that said photodetectors are aligned with said fiber sockets, and then performing said step of bonding said first and second layers together to provide said composite wafer.

24. The method of claim 21 further comprising:

forming a plurality of optical focusing elements in said second layer in a predetermined configuration corresponding to the configuration of said fiber sockets; and

aligning said first layer with said second layer so that said optical focusing elements are aligned with said fiber sockets, and then performing said step of bonding said first and second layers together to provide said composite wafer.

25. The method of claim 210 wherein said step of forming said plurality of optical focusing elements comprises forming refractive lenses.

26. The method of claim 210 wherein said step of forming said plurality of optical focusing elements comprises forming diffractive lenses.

27. The method of claim 210 wherein said step of forming said plurality of optical focusing elements comprises forming gradient-index lenses.

28. The method of claim 21 wherein said second layer comprises an optical material that has

an index of refraction substantially equal to the index of refraction of said optical fiber, and said step of affixing said optical fibers into said fiber sockets includes applying an epoxy that approximately matches the index of refraction of said optical fiber into the fiber sockets to fill the gap between adjacent sections of said second layer and said optical fiber.

29. The method of claim 21 wherein said step of bonding said first and second layers comprises anodic bonding.

30. The method of claim 21 wherein said step of bonding said first and second layers comprises epoxy bonding.

31. The method of claim 21 wherein said step of bonding said first and second layers comprises metal solder bonding.

32. The method of claim 21 wherein said dicing step comprises cutting partially through said composite wafer, then performing said affixing step to affix optical fibers to said fiber sockets, and then physically separating said composite wafer into chips, each of which comprises one or more optical couplers.

33. The method of claim 21 and further comprising bonding a third layer that comprises an optical device to said second layer.